CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

USER MANUAL

CM110, CM115, CM120
Tripod Installation

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CSL 685

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Campbell Scientific Ltd,
Campbell Park, 80 Hathern Road,
Shepshed, Loughborough, LE12 9GX, UK
Tel: +44 (0) 1509 601141
Fax: +44 (0) 1509 601091
Email: support@campbellsci.co.uk
www.campbellsci.co.uk

PLEASE READ FIRST

About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

Area: 1 in^2 (square inch) = 645 mm^2

Length: 1 in. (inch) = 25.4 mm
1 ft (foot) = 304.8 mm
1 yard = 0.914 m
1 mile = 1.609 km

Mass: 1 oz. (ounce) = 28.35 g
1 lb (pound weight) = 0.454 kg

Pressure: 1 psi (lb/in^2) = 68.95 mb

Volume: 1 UK pint = 568.3 ml
1 UK gallon = 4.546 litres
1 US gallon = 3.785 litres

In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to European users.

Differences include the U.S standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for British/European use. *Please note, however, that when a power supply adapter is ordered it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials may also not be applicable according to your locality.

Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the European market; in some cases alternatives are offered. Details of the alternatives will be covered in separate manuals.

Part numbers prefixed with a "#" symbol are special order parts for use with non-EU variants or for special installations. Please quote the full part number with the # when ordering.

Recycling information

At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.

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Campbell Scientific Ltd, Campbell Park, 80 Hathern Road, Shepshed, Loughborough, LE12 9GX, UK
Tel: +44 (0) 1509 601141 Fax: +44 (0) 1509 601091
Email: support@campbellsci.co.uk
www.campbellsci.co.uk

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Tripod Installation Manual
Models CM110, CM115, CM120

1. General

The CM110 (3 m), CM115 (4.7 m), and CM120 (6.4 m) tripods are corrosion-resistant stainless steel instrument mounts that support the attachment of sensors, solar panels, and environmental enclosures. A guy kit is included with the CM115 and CM120 models, and is an option for the CM110. A durable Tripod Tote Bag is available as an option.

Figure 1-1. CM110 Tripod with Optional Guy Kit

2. Specifications

	CM110	**CM115** (see note 3)	**CM120** (see note 3)
Height w/mast insert:	3 m (10’)	4.7 m (15.5’)	6.4 m (21.0’)
Weight:	15 kg (34 lbs)	18 kg (40 lbs)	21 kg (46 lbs)
Base diameter w/legs extended:	2 m (7 ft)	2 m (7 ft)	2 m (7 ft)
Dimensions of collapsed tripod:	15 x 15 x 145 cm (6” x 6” x 57”)	15 x 15 x 145 cm (6” x 6” x 57”)	15 x 15 x 145 cm (6” x 6: x 57”)
Vertical load limit:	45 kg (100 lb)	45 kg (100 lb)	45 kg (100 lb)
Mast description			
Number of sections:	1	2	3
Length:	1.4 m (4.6’)	2.8 m (9.3’)	4.3 m (14.0’)
Length w/insert:	2.6 m (8.6’)	4.1 m (13.3’)	5.5 m (18.0’)
OD:	4.8 cm (1.9”)	4.8 cm (1.9”)	4.8 cm (1.9”)
Insert OD:	4.45 cm (1.75”)	4.45 cm (1.75”)	4.45 cm (1.75”)
Mounting hole in tripod foot:	0.75” diameter hole for user-supplied 0.5” J-bolts	0.75” diameter hole for user-supplied 0.5” J-bolts	0.75” diameter hole for user-supplied 0.5” J-bolts
Wind load recommendations			
Sustained wind (mph):	*75 (unguyed) 80 (guyed at feet)	*56.25 (guyed at feet) 75 (guyed at 60°)	*42.25 (guyed at feet) 65 (guyed at 60°)
Gust tolerance (mph):	95 (unguyed) 100 (guyed at feet)	71.25 (guyed at feet) 95 (guyed at 60°)	55.25 (guyed at feet) 85 (guyed at 60°)
Tote bag dimensions:	20 cm (8”) diameter, 152 cm (60”) length	20 cm (8”) diameter, 152 cm (60”) length	20 cm (8”) diameter, 152 cm (60”) length

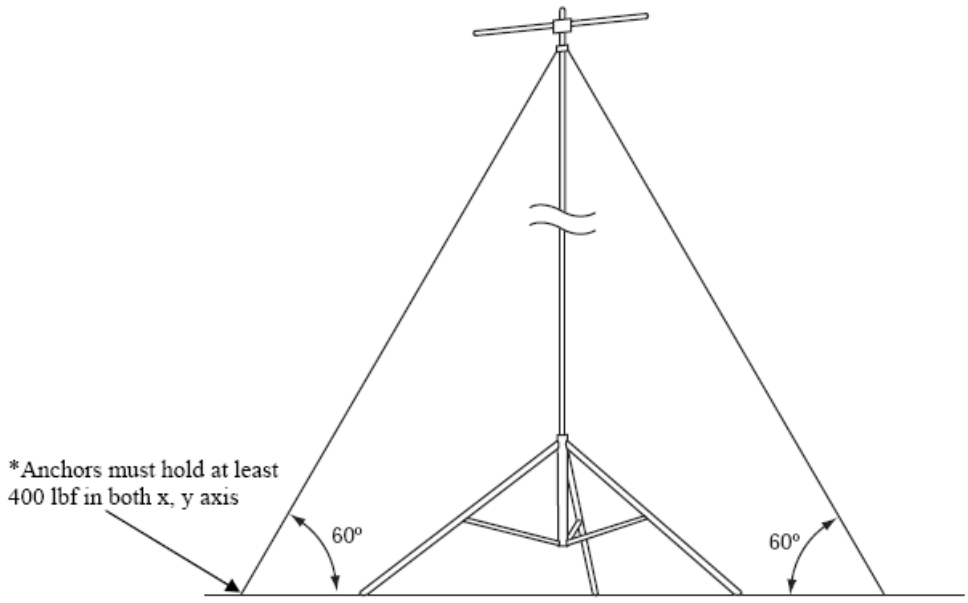


Figure 2-1. 60-Degree Guy Angle

3. Tools List (for tripod, mast and crossarm)

1/2” and 7/16” open end wrenches
adjustable wrench
socket wrench with 1/2”and 7/16” deep sockets (optional)
Phillips head screw driver (medium)
Straight bit screwdriver (large)
12” torpedo level
side-cut pliers
pencil
tape measure
compass and site declination angle
shovel
sledge hammer (for driving ground rod and stakes)
step ladder

4. Tripod Components

Figure 4-1 shows the tripod components packaged for shipment. The tripod base is packaged with the mast, ground rod, lightning rod and (6) stakes. The ground rod clamp, lightning rod, and grounding wires are enclosed in a bag. The guy kit (optional for the CM110), and tripod tote bag (optional) are packaged separately. The CM115 and CM120 tripods include additional mast sections. A diagram showing how to stow the components inside the tote bag is shown in Appendix A.

Figure 4-1. Tripod Components

5. Tripod Installation

5.1 Tripod Base

WARNING **Tripod installation near power lines is dangerous. The minimum safe recommended distance from overhead power lines is 2 times the height of the tripod and mast combined. Call Blue Stakes to locate buried utilities prior to installation.**

All three models of tripods use the same tripod base. Each leg is adjustable, which allows the tripod to be adjusted for non-level terrain.

Prepare the area where the tripod will be installed. The tripod requires an area approximately 7 feet in diameter. Natural vegetation and the ground surface

should be disturbed as little as possible, but brush and tall weeds should be removed.

Stand the tripod base up on end, and rotate the feet perpendicular to the legs. Each leg has a slide collar with a spring loaded pin that locks into holes located on the underside of the leg as shown in Figure 5-1.

Extend each leg until the pin engages in a hole (depress the tab to disengage the pin from a hole). With the legs extended, orient the tripod so that the open channel of the tripod base faces North. The tripod is typically plumbed after the mast has been installed, as described in Section 5.2.

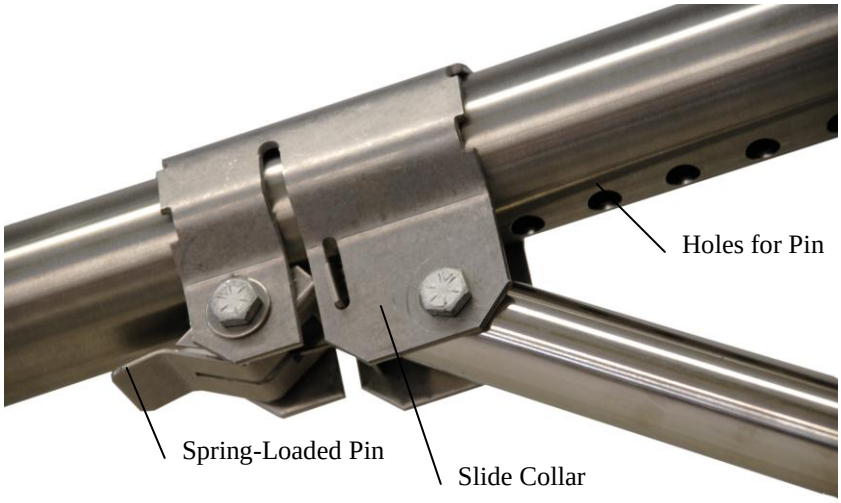


Figure 5-1. Tripod Leg, Slide Collar Components

5.2 Mast

The CM110, CM115 and CM120 tripods have one, two or three mast sections respectively. The top mast section has a 56” long insert with a series of holes that can be extended to lengthen the mast. Remove the bolt that secures the insert to the inside of the mast, and slide the insert out from the mast to see the different hole locations. Slide the insert back into the mast, aligning the appropriate holes of the insert with holes in the mast, and replace the bolt.

Additional 56” mast section(s) included with the CM115 and CM120 tripods have a 16” long insert that is used to connect the mast sections together. Remove the bolt that secures the insert to the inside of the mast and extend the insert 8”. Align the holes and replace the bolt. Attach additional mast sections by sliding the bottom of the next mast section over the insert of a lower section, aligning the holes and installing the bolt. Typically the bottom mast section is attached to the tripod and tilted down to a horizontal position, and the additional mast sections bolted to the bottom section.

Figure 5-2. Tripod Mast and Insert

The tripod base has two sets of right-angled holes for attaching the mast; typically the lower set is used (Figure 5-4A). The mast is attached to the base with a pin, and secured in the upright position with a locking bracket. Both the pin and the locking bracket are secured with a lanyard.

To attach the lower mast section, hold the mast upright and align the hole in the bottom of the mast with the holes in the tripod base. Insert the pin through the holes, and rotate the wire retainer over the end of the pin as shown in Figure 5-4B. The pin should be seated in the bottom of the hole when the mast is upright. Lift the mast up so that the pin is in the upper end of the hole to allow the mast to be tilted down to a horizontal position.

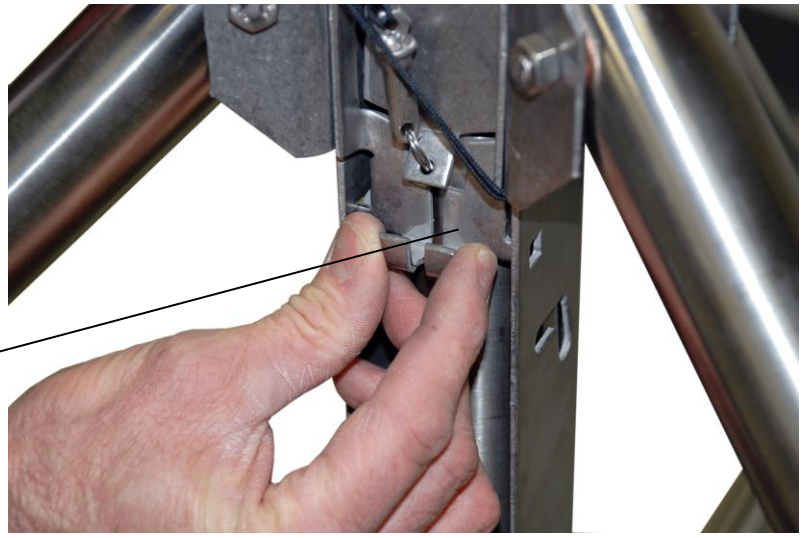
Figure 5-3. Mast Attachment to Tripod Base

Secure the mast in the upright position by installing the locking bracket (Figure 5-4A). Insert the top of the bracket into the notches in the tripod base, and using both thumbs, press the bracket into the body of the base until the lower tabs lock into position. Install the pin as shown in Figure 5-4C. To remove the bracket, remove the pin and squeeze the lower part of the bracket to disengage the tabs, then rotate the bracket out and up.

Plumb the tripod by adjusting the northeast and south facing legs. With a level on the East side of the mast, adjust the Northeast leg for plumb. With the level on the South side of the mast, adjust the South leg for plumb.

A

B



C

Figure 5-4. Mast Lock Bracket

5.3 Installing the Guy Kit

The CM115 and CM120 tripods include a guy kit; the guy kit is an option for the CM110. With the mast tilted down in the horizontal position, install the guy collar over the mast insert, and attach the guy wires as shown in Figure 5-5. Return the mast to the upright position and install the locking bracket.

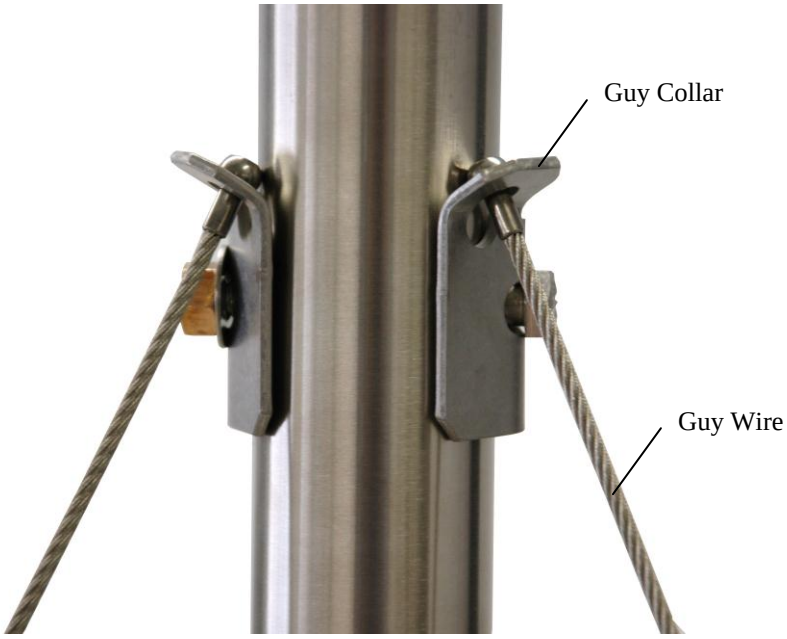


Figure 5-5. Guy Collar

On the end of each guy line is a case consisting of a hook, clamp, and lever arm. Rotate the lever arm to the "open" position, and attach the hook to the tripod leg as shown in Figure 5-6. Loosen the Phillips screw, and remove the slack in the guy line by feeding the load end of the guy wire through the wedge while pulling up on the dead end (Figure 5-7).

After the slack has been removed from the guy lines, tighten the Phillips screws and rotate the lever arms to "closed" position to tension the guy lines.

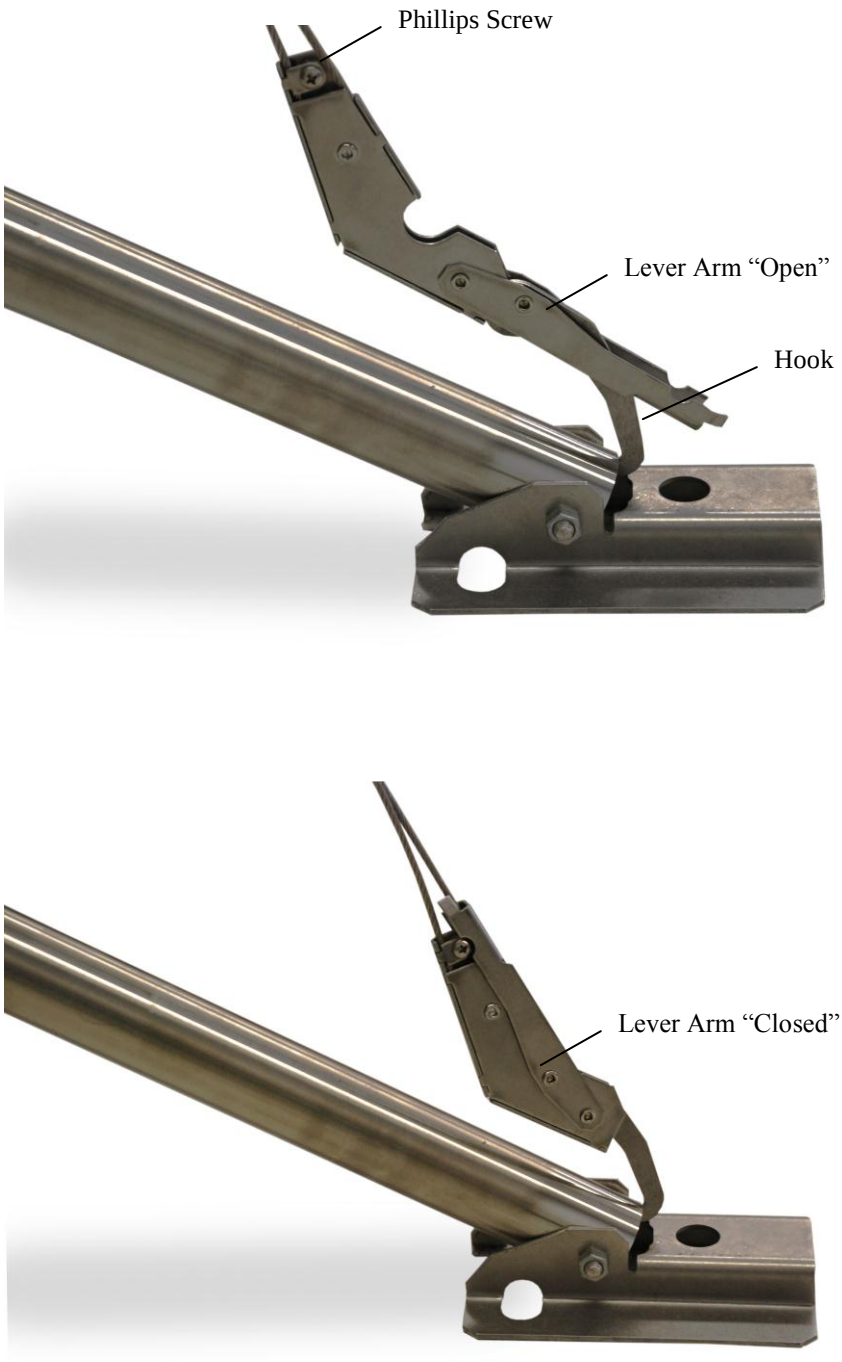


Figure 5-6. Guy Cinch and Lever Arm

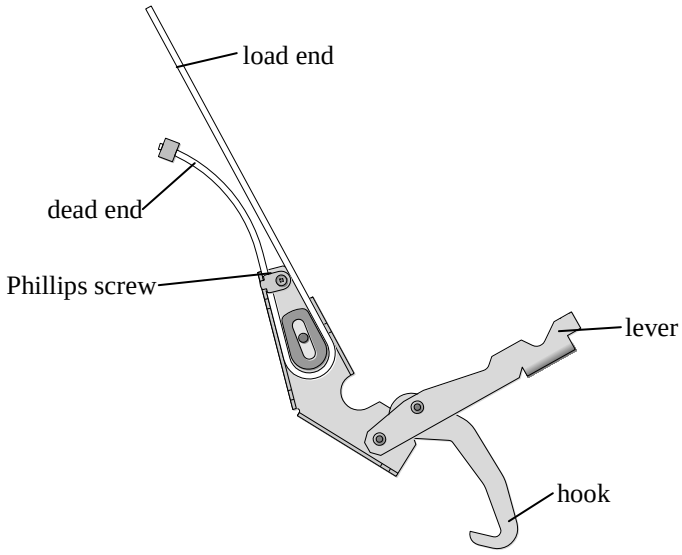


Figure 5-7. Mechanical Drawing of Guy Hook and Case

5.3.1 Guy Duckbill Anchor Kits

Duckbill anchors are recommended for areas subjected to higher winds. They allow the guy wires to be anchored at points beyond the feet, thereby increasing the rating of the tripod for higher winds.

Two duckbill anchor kits are offered for these lightweight tripods. The #19282 Guy Duckbill Standard Anchor Kit is for standard soils, and the #25699 Guy Duckbill Heavy Duty Kit is for aggressive soils. Aggressive soils have:

- Resistivity of less than 3000 ohm-cm
- pH of less than 5
- Chloride of greater than 1000 ppm
- Sulphate of greater than 500 ppm
- Poor aeration.

Both the #19282 and #25699 have one drive bar. The #19282 also has four duckbill anchors with a cable attached to each of them. At the end of the cable is a loop for connecting the guy wires. The #25699 has a threaded rod attached to each of the four duckbill anchors instead of the cable. At the end of the threaded rod is a metal ring for connecting the guy wires.

The duckbill anchors are driven to the ground at a 60-degree guy angle as shown in Figure 5-8. Locate the anchors on a 2.3 m radius for the CM115, or a 3 m radius for the CM120 as shown in Figure 5-9. Specifications for sustained wind speed and gust tolerance are given based on guy angle, and the ability of the anchors to hold at least 180 kgf.

NOTE Duckbill anchors are not suitable for rocky or sandy soils; the UTEYE anchors should be considered for these types of soils.

It is important that the anchors be driven at the same angle as the guy wires. Insert the drive bar into the anchor body and drive the anchor into the ground using a sledgehammer until only the top half of the loop or metal ring remains above the ground. Place a bar or highlift jack through the loop or metal ring and jack the anchor up about four inches to rotate the anchor into the load-lock position.

WARNING **Failure to install and lock the anchor at the correct angle will result in the anchor cable cutting through the soil until the angles equalize, causing slack**

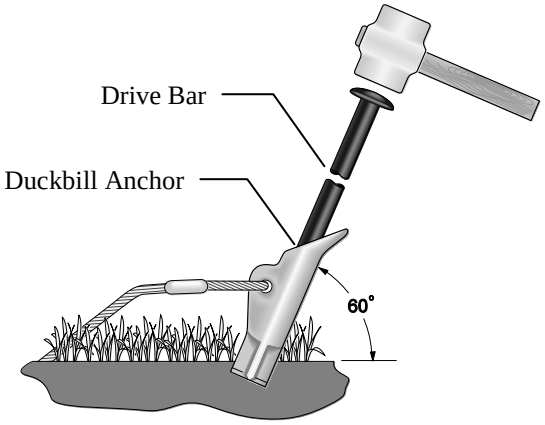
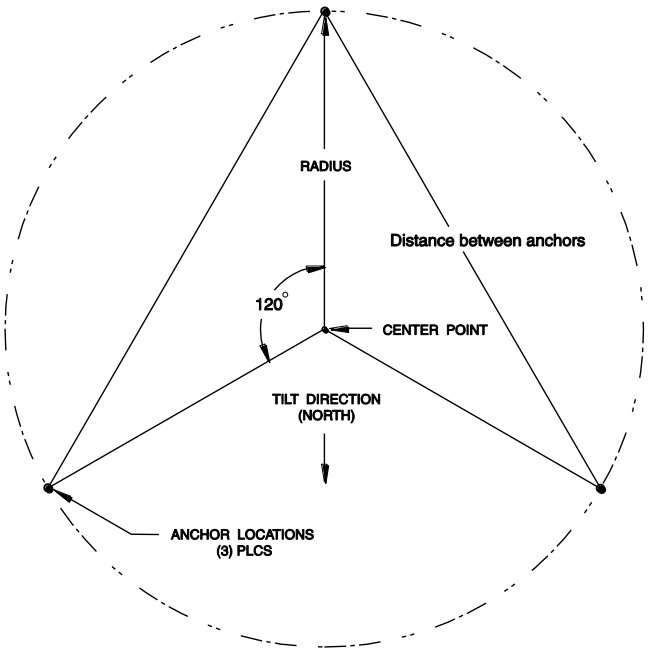


Figure 5-8. Duckbill Guy Anchor



	Radius	Distance Between Anchors
CM115	2.3 m	4 m
CM120	3.0 m	5.3 m

Figure 5-9. Top View and Guy Anchor Layout

5.3.2 Lowering Mast after Attaching Guy Wires

Once the guy lines have been adjusted the lever arms can be "opened" and the guy hooks removed to allow the mast to be lowered to the horizontal position.

5.4 Staking the Tripod Feet

Six stakes are provided for securing the tripod feet to the ground. Drive two stakes through holes in each foot at an angle as shown in Figure 5-10.

Stakes may not be adequate depending on soil structure, maximum wind speeds experienced at the site, mast height, or wind load from the instrumentation. For questionable situations, additional stakes (#17049) or even concrete footings for the tripod feet and guy anchors should be considered.

Figure 5-10. Staking the Tripod Feet

5.5 Tripod Grounding

Place the clamp over the ground rod and drive the rod (close to the centre of the tripod) using a sledge hammer or fence post driver. Strip 2 cm of insulation from both ends of the black 4 AWG ground wire. Insert one end of the ground wire between the clamp and ground rod and tighten the bolt on the clamp. Attach the other end of the ground wire to the lug on the tripod base as shown in Figure 5-12.

Figure 5-11. Ground Rod and Clamp

Strip 2 cm of insulation from the ends of the green 12 AWG wire. Attach one end of the wire to the tripod ground lug, and the other end to the enclosure ground lug as shown in Figure 5-12.

Mount the lightning rod and clamp to the tripod mast as shown in Figure 5-12.

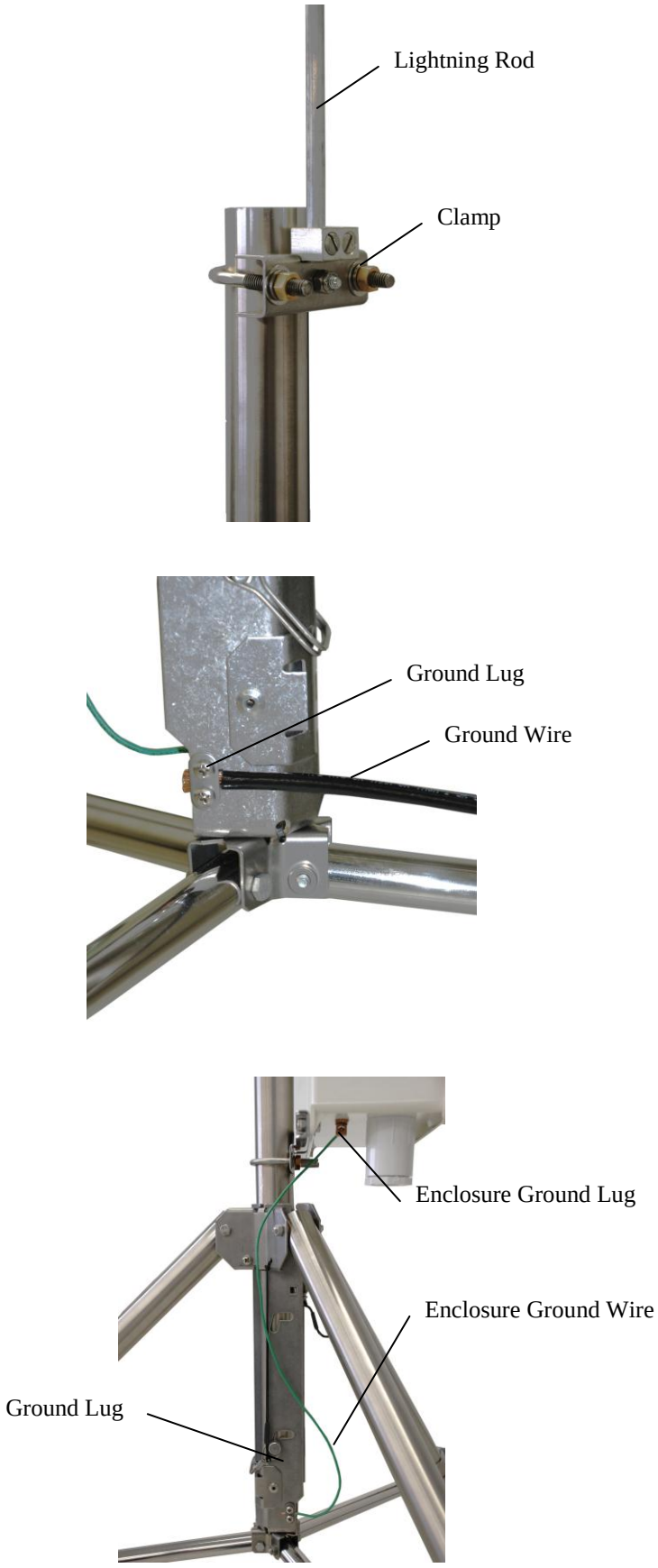


Figure 5-12. Lightning Rod and Tripod Grounding Lug

5.6 Enclosure Attachment

The ENC 10/12, ENC 12/14, ENC 14/16, and ENC 16/18 enclosures can be ordered with mounting brackets for the CM100 series tripods. All enclosure models can be mounted to the tripod mast (above the legs) with the –MM Mast Mount bracket option. All enclosure models except the ENC 16/18 can be mounted to the tripod base and leg with the –LM Leg Mount bracket option. Two enclosures with the –LM brackets can be mounted in a "back to back" configuration.

5.6.1 Enclosure Mounting to Tripod Mast

An enclosure ordered with the –MM bracket has a three-piece top and bottom brackets with a U-bolt for each bracket.

Attach an enclosure with the –MM mounting bracket to the tripod mast as follows:

Remove the U-bolts washers and nuts from the brackets.

Position the enclosure against the tripod's mast (North side recommended).

Install the U-bolts, flat washers, lock washers, and nuts. Tighten the nuts until the lock washers are compressed.

Route the 14 AWG wire from the grounding lug on the bottom side of the enclosure to the grounding lug on the base of the tripod (Figure 5-13). Strip 1/2" of insulation from each end of the wire. Insert wire ends into the grounding lugs and tighten.

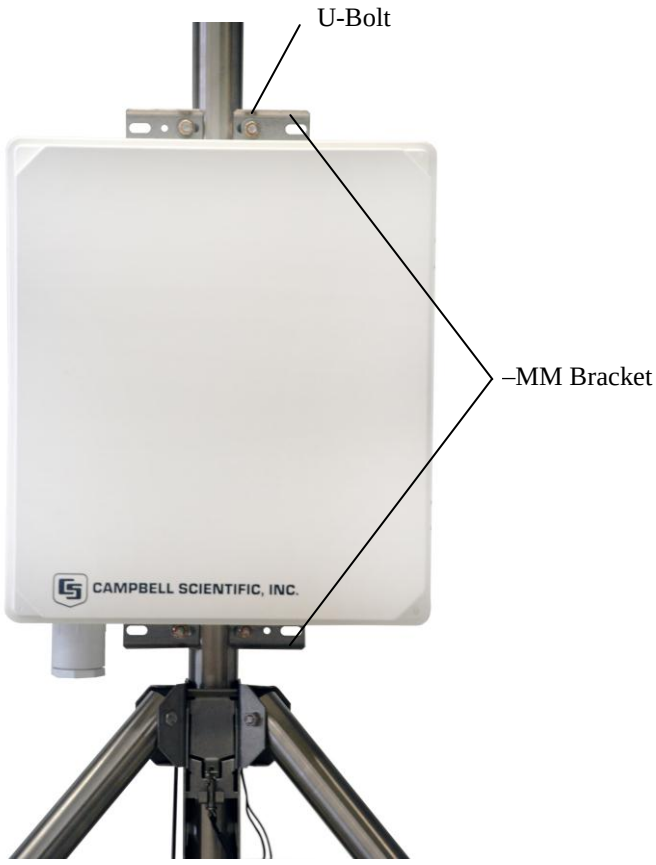


Figure 5-13. Enclosure with the –MM Bracket

5.6.2 Enclosure Mounting to Tripod Leg

An enclosure ordered with the –LM bracket has a bracket on each side of the enclosure, and a U-bolt bracket for securing the enclosure to a tripod leg.

Attach an enclosure with the –LM mounting bracket to the tripod base as follows:

Slide the keyhole notch in the upper corner of the –LM bracket over the extended Phillips head screw located on the tripod base as shown in Figure 5-14. Pivot the enclosure so the square slot in the bottom corner slides into the square tab.

Remove the washers, nuts and U-bolt from the U-bolt bracket. Install the bracket as shown in Figure 5-14. Tighten the nuts on the U-bolt until the lock washers are compressed.

Route the 14 AWG wire from the grounding lug on the bottom side of the enclosure to the grounding lug on the base of the tripod (Figure 5-14). Strip 1/2" of insulation from each end of the wire. Insert wire ends into the grounding lugs and tighten.

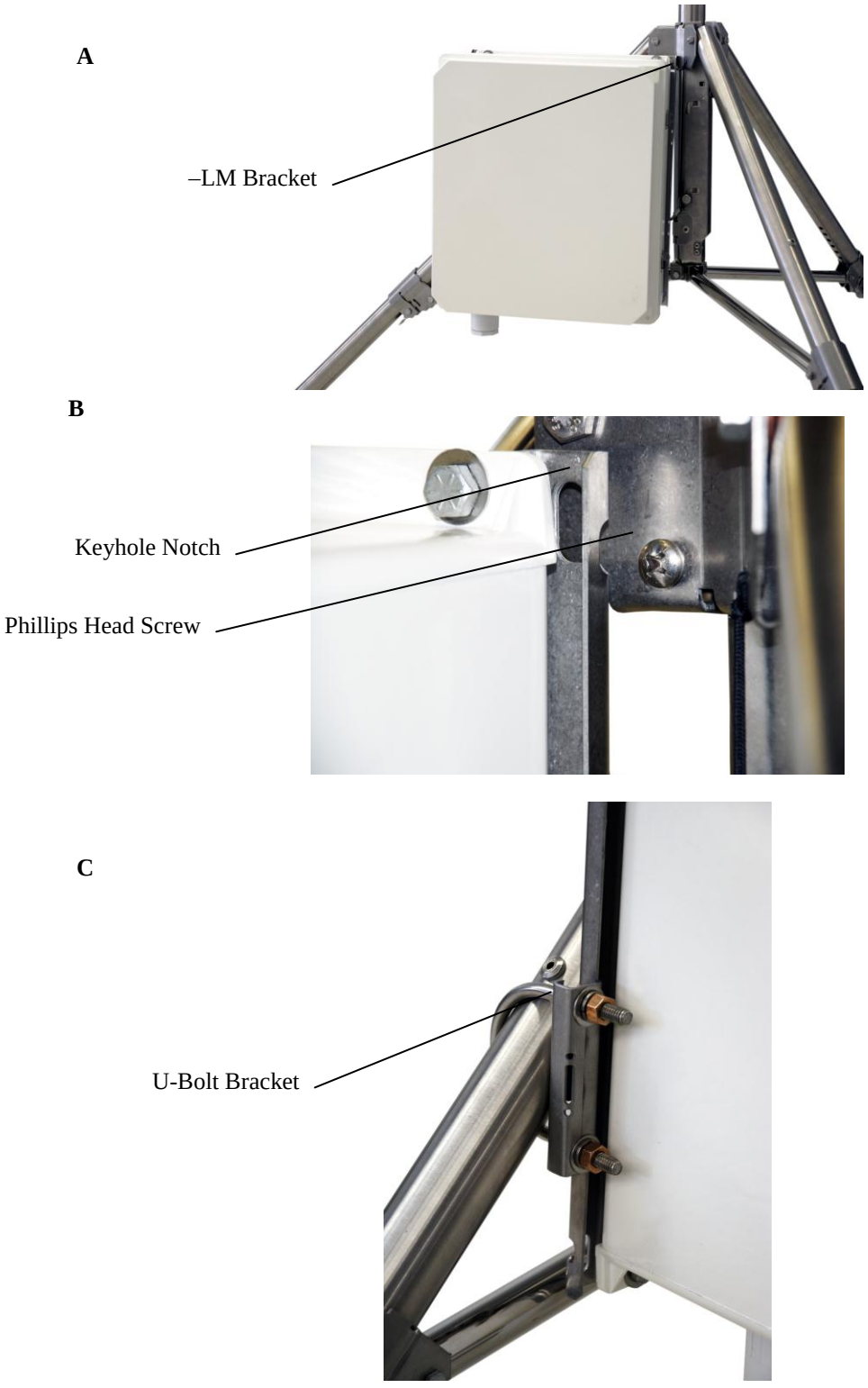


Figure 5-14. Enclosure with the –LM Bracket

6. Sensors, arms and brackets

This section describes a range of crossarms and brackets that are used to mount sensors on the tripod or mast. Typically, one or more crossarms are used with sensors mounted at the end of the arms, using brackets which are attached to the arms.

NOTE 1. This section does not cover sensors which may not be mounted on the mast or tripod (e.g. tipping bucket raingauge) or which are not part of a standard weather station (e.g. snow depth gauge). For installation details for these sensors please refer to the manuals provided or contact Campbell Scientific for assistance.

2. This Section describes four different sensor mounting arms. Most weather stations will only use one or two of these arms. When there is more than one arm, ensure that wind sensors are on the higher arm so that the other arm does not affect the wind measurements.

6.1 Mounting Brackets

Mounting brackets covered in this section have V-bolts that attach to vertical and/or horizontal pipes with the following ranges of outside diameters:

V-bolt Description	OD Range
46 mm	25 to 38 mm
62 mm	33 to 54 mm
62 m w/plastic V-block	25 to 54 mm

Some of the brackets (e.g. the CM210) include 38 mm and 50 mm V-bolts to extend the range of pipe diameters that the bracket can accommodate. Brackets with holes for a 38 mm V-bolt will accept a user-supplied 44 mm V-bolt.

6.1.1 CM200E Crossarms and the CM210E Crossarm Mounting Kit

CM200E series crossarms include a CM210E bracket as shown in Figure 6-1.

Attach the CM202E (0.6 m, 2ft), CM204E (1.2 m, 4ft), or CM206E (1.8 m, 6 ft) crossarm to the tripod mast as shown in Figure 7. For wind sensors, the crossarm should be approximately 2.62 m above the ground for a 3 m mounting height, or 1.63 m for a 2 m mounting height. Typically, the crossarm is oriented East/West for wind sensors, North/South for pyranometers.

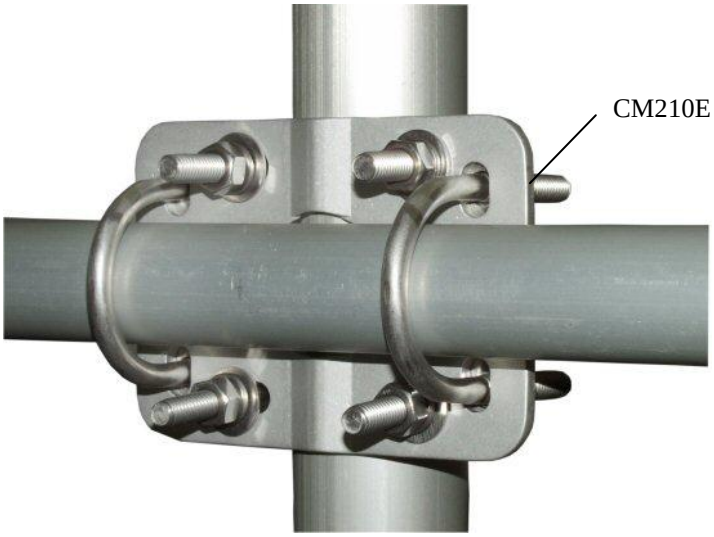


Figure 6-1. CM210E Crossarm Mounting Kit (shown with user-supplied pipe)

6.1.2 Mounting the Wind Monitor, Wind Sentry or the WXT520 Sensor

These sensors are normally mounted at the end of a crossarm on a 33 mm OD vertical pipe supplied with the sensor. One of two types of brackets are used to mount the pipe.

1) Campbell Scientific offers NU-RAIL® Slip-on Crossover fittings that can be used to mount a sensor with a vertical pipe mount on to a CM202E, CM204E, or CM206E crossarm. Part 008285 is required for sensors that have a 33 mm OD (1" IPS) mounting pipe.

   NU-RAIL® Sensor Compatibility
   Sensors supplied with 33 mm OD (1" IPS) mounting pipe:

   03001 Wind Sentry Set
   05103 Wind Monitor
   05106 Wind Monitor Marine
   05305 Wind Monitor
   WXT520

   The NU-RAIL® fitting is slid onto the tubes and fixed in place by tightening the `Allen' grub screws (four in total) using the `Allen' key supplied.

Figure 6-2. NU-RAIL® Fitting

2) An alternative to the NU-RAIL® bracket, is the CM220 bracket, fitted in a similar way as shown in Figure 6-3 below.

Figure 6-3. CM220 Right Angle Bracket with a Wind Monitor and vertical pipe

NOTE If you are using a Wind Monitor with an SPM2 Mast, an adapter is available which allows the Wind Monitor to fit directly onto the top of the mast assembly.

6.1.3 Vector Instruments Wind Speed/Direction Sensors and the 011E Crossarm

The 011E crossarm sensor mount is also supplied with a CM210E bracket. The mast/tripod and 011E arm are normally adjusted so that the cups and vane of the windset are at a specified height above the ground (approximately 2 m for the SPM2 Mast and CM10/2, and 3 m for the CM10/3). Orient the 011E at 90° to the arm with any solar radiation sensor on it. It is recommended that the 011E arm is mounted in an approximately East-West direction to make it easier for wind sensor adjustment – see Appendix A. The crossarm is normally mounted at its midpoint.

Once the wind sensors are mounted, you may need to rotate them to ensure correct wind direction readings or to move the cable to a convenient position. A pair of spacers and long screws are included with the 011E to allow this. In addition, a nylon washer is supplied which can be used to stop the spacer and screw falling out of the crossarm during installation.

Ensure that the crossarm is level in both directions using the spirit level. If it is not, for a tripod mounted unit, you can adjust the tripod legs. Mount the wind sensors as follows:

1. Take the stainless steel washer supplied with the sensor and place it over one of the long screws.
2. Push the screw through the 011E from below.
3. Put the spacer over the screw from the top, with the end with the smaller internal diameter facing downwards.
4. Screw the nylon washer onto the free end of the screw for a few threads; it will be a tight fit but can be screwed on by hand. You can now release the screw and spacer without them falling out.
5. Fit the wind sensor onto the screw, orient it appropriately (see below) and tighten the screw to lock it into position. This will push the nylon washer into the recess in the spacer.

NOTE The vane of the direction sensor should be locked into position on the spindle and the body of the sensor oriented so that it points to *true* North — please refer to Appendix A for further details.

CAUTION

1. Ensure that the rotor of the Vector wind speed sensor and the vane of the wind direction sensor are correctly fitted, as described in the sensor manuals. Failure to do so can lead to false measurements or damage to the sensors.

2. Do not attempt to remove the rotor of the wind speed sensor or the vane of the wind direction sensor with the sensors fixed to the crossarm. The correct procedure is described in the sensor manuals.

6.1.4 Pyranometers and Solarimeters using the CM225E Pyranometer Mounting Stand

The CM225E Pyranometer Mounting Stand includes one 62 mm V-bolt with plastic V-block for attaching a solar radiation sensor to a crossarm or mast. Compatible sensors include the SP110, SKP215, CMP3, LP02, SR11 and CS300.

Typically, the CM225E and sensor is mounted at the end of a CM200 series arm in a position where the sensor is not shaded throughout the day. The CM225E can be mounted on a short arm (CM202E) or at the end of a longer arm (CM206E), with a wind sensor at the opposite end on the other side of the mast.

The CM225E stand can also be used with the GPS16X-sensor.

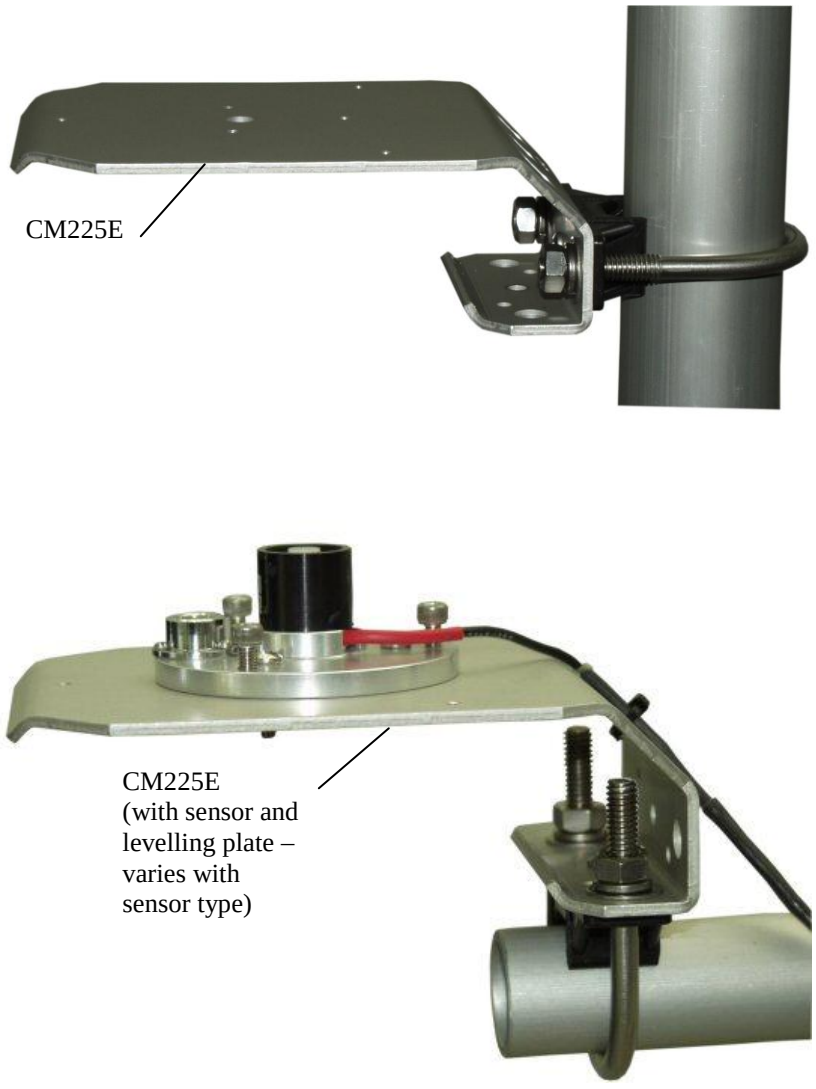


Figure 6-4. CM225E Pyranometer Mounting Stand

6.1.5 Satellite Antenna using the CM230 Adjustable Angle Mounting Kit

The CM230 mounts an antenna (25-38 mm OD) to a mast or vertical pipe (33-54 mm OD) as shown in Figure 6-5. The bracket allows the antenna to be adjusted for different angles.

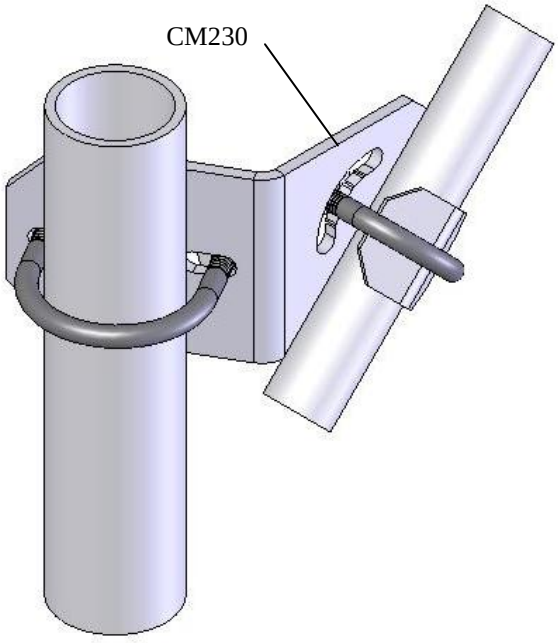


Figure 6-5. CM230 Adjustable Angle Mounting Kit

6.1.6 Specialist Antenna using the CM235 Magnetic Mounting Stand

The CM235 provides a 8.8 cm square platform for mounting magnetic base antennas. The CM235 attaches to horizontal or vertical pipes (25-54 mm OD) as shown in Figure 6-6.

Figure 6-6. CM235 Magnetic Mounting Stand

6.1.7 Temperature and Humidity Probes – in the RM Young Gill Radiation Shield or the Met 20/21 Radiation Shield

Radiation Shields are used to house and attach temperature and relative humidity sensors to the tripod mast or crossarm as shown in Figure 6-7. Radiation shields ship with the U-bolt or V-bolt configured for attachment to a vertical pipe. To attach the radiation shield to a horizontal pipe, the U-bolt and plastic V-block must be moved to the other set of holes.

Figure 6-7. RM Young Gill Radiation Shield

In Europe the temperature and humidity sensors are normally mounted at 1.2 or 2 m (country standards vary) so the shield is fitted at a suitable height on the main vertical pole of the tripod or mast to suit.

NOTE The option for horizontal pipe mounting for the Met 20/21 is a special order part.

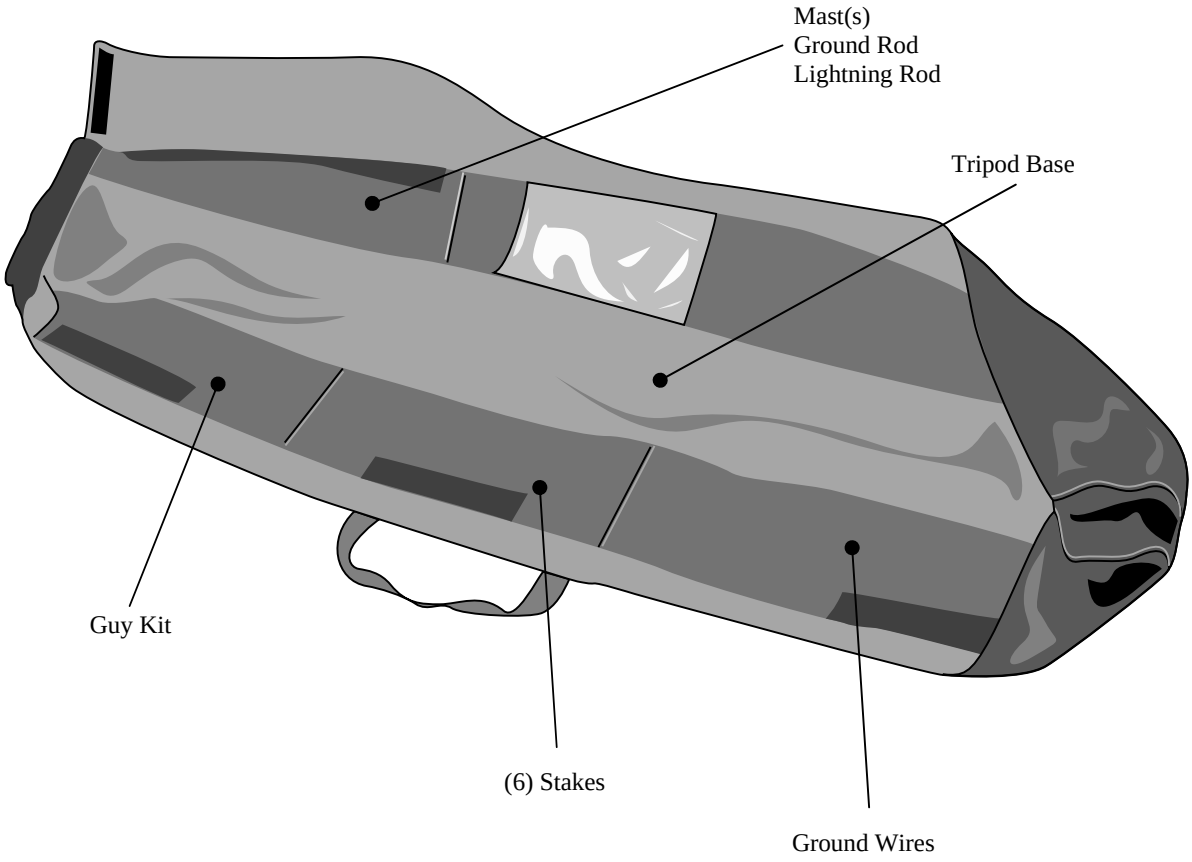
6.1.8 CM216E Mast Mounting Kit

The CM216E provides a 27 mm OD (3/4” IPS) or 33 mm OD (1” IPS) mounting pipe that extends 10 cm (4”) above the mast. It allows sensors with a 27 mm or 33 mm OD fitting (typically a wind sensor) to be attached directly to the top of a stainless steel CM110E, CM115E, or CM120E tripod. Please note that use of a lightning rod is recommended; a lightning rod can be attached to this configuration but cannot be attached to a configuration that deploys a Wind Monitor. Therefore, the Wind Monitor configuration is recommended for short-term deployments only.

Figure 6-8. CM216E Mast Mounting Kit

Appendix A. Tripod Tote Bag

The Tripod Tote Bag is an option for the CM110 series tripods. The bag is constructed of nylon, with a main compartment for the tripod base, and pockets for stowing the other components as shown below:



CAMPBELL SCIENTIFIC COMPANIES

Campbell Scientific, Inc. (CSI)
815 West 1800 North
Logan, Utah 84321
UNITED STATES
www.campbellsci.com • info@campbellsci.com

Campbell Scientific Africa Pty. Ltd. (CSAf)
PO Box 2450
Somerset West 7129
SOUTH AFRICA
www.csafrica.co.za • sales@csafrica.co.za

Campbell Scientific Australia Pty. Ltd. (CSA)
PO Box 8108
Garbutt Post Shop
QLD 4814 AUSTRALIA
www.campbellsci.com.au • info@campbellsci.com.au

Campbell Scientific do Brazil Ltda. (CSB)
Rua Luisa Crapsi Orsi, 15 Butantã
CEP: 005543-000 São Paulo SP BRAZIL
www.campbellsci.com.br • suporte@campbellsci.com.br

Campbell Scientific Canada Corp. (CSC)
11564 - 149th Street NW
Edmonton, Alberta T5M 1W7
CANADA
www.campbellsci.ca • dataloggers@campbellsci.ca

Campbell Scientific Centro Caribe S.A. (CSCC)
300N Cementerio, Edificio Breller
Santo Domingo, Heredia 40305
COSTA RICA
www.campbellsci.cc • info@campbellsci.cc

Campbell Scientific Ltd. (CSL)
Campbell Park
80 Hathern Road
Shepshed, Loughborough LE12 9GX
UNITED KINGDOM
www.campbellsci.co.uk • sales@campbellsci.co.uk

Campbell Scientific Ltd. (France)
3 Avenue de la Division Leclerc
92160 ANTONY
FRANCE
www.campbellsci.fr • info@campbellsci.fr

Campbell Scientific Spain, S. L.
Avda. Pompeu Fabra 7-9
Local 1 - 08024 BARCELONA
SPAIN
www.campbellsci.es • info@campbellsci.es

Campbell Scientific Ltd. (Germany)
Fahrenheitstrasse13, D-28359 Bremen
GERMANY
www.campbellsci.de • info@campbellsci.de

Please visit www.campbellsci.com to obtain contact information for your local US or International representative.